

# Re-engineering New Zealand tertiary education

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## Abstract

A tertiary education system is dynamic and responds to influence. The problem is that it is difficult to anticipate the behaviour of such a complex system. There are few, if any system models available, and not many methodologies to generate such models. The hypothesis in this paper was that a system model could be developed to qualitatively explain the observed behaviour of the NZ tertiary education system. This is worth doing as such a model may be able to (i) advance understanding of existing system behaviour, and (ii) help decision-makers anticipate the dynamic response of the system. This paper applied dynamic process analysis (DPA) to produce a diagrammatic and hierarchical system model of qualitative aspects NZ tertiary education. Results include sub-models for how an international student selects a destination country, selection of institution, the study process, management of a teaching section (including teaching quality, research and financial viability), the setting and implementation of strategies by senior management, and marketing activities. The dominant failures of the NZ education system were observed to be destructive competition and the financial insecurity of tertiary education institutions (TEIs). These are consequences of the state distributing its entire teaching subsidy according to the student enrolment, with no constraints on where or what the student studies, and no other continuing sources of state funding being available for capital or special needs. Furthermore, institutions have transformed themselves to meet the operating environment with proliferation of programmes, including expansion into academic areas formerly reserved for other institutions. Since the student's enrolment decision carries the entire subsidy, institutions have had to focus on student needs before other priorities of the national good. The government intends to change the behaviour of tertiary institutions and the mechanisms it intends using are critically reviewed. It is readily acknowledged that this model is a construct of the analysts and is therefore subjective. It nonetheless has the ability to provide a plausible explanation of a complex and dynamic environment in which there is a lack of system models. The model has the potential to help other organisations better understand and respond to their environment.

**Keywords:** tertiary education, New Zealand, dynamic process analysis, IDEF0, system model

## 1 Introduction

The New Zealand (NZ) tertiary education system entered a period of profound change starting from about 1989. At this time the NZ government perceived insufficient relevance of education/training for national needs and that tertiary education was a private as well as a public good. A different control strategy was adopted, namely a competitive market-driven funding model instead of direct central control via a financial bureaucracy. Changes consistent with this strategy were introduced, and continue to be introduced. The effects of these changes are still being propagated, resulting in a high level of perturbation throughout the system.

Student fees for university study were introduced, polytechnics began expanding into degree programmes, private training establishments (PTEs) began to get state subsidy, industry training organisations (ITOs) were formed, and vocational training was redeveloped into unit standard based competency assessment. With time there has been a proliferation of number of academic programmes on offer, a veritable explosion in personal interest courses (community education), reducing state subsidy per equivalent full time student (EFTS), and serious financial difficulties for some institutions. In this current environment the full state subsidy goes wherever the student enrolls. There are no constraints on the student as to course or location. Nor does the Ministry of Education (MoE) provide capital, buildings, plant or any other funding to TEIs, with the exception of the funding that has been available to a

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very limited number of institutions under the TEC Partnerships for Excellence programme. Thus the student choice entirely determines the financial viability of the TEI.

The NZ system began to be successful in producing large numbers of graduates with degrees, diplomas and certificates, across more subject areas than before. However, other weaknesses were apparent by 2001 when the NZ government appointed a Tertiary Education Commission (TEC) to investigate [1]. They concluded that there was financial difficulty for education providers, pathologically destructive competition, duplication of programmes, potentially reduced quality of research, and the inability to meet social needs especially for indigenous peoples [2, 3]. Consequently, the government set about attempting once again to correct the system.

## 2 Problem definition

A tertiary education system is dynamic and responds to influence. Nations regularly tweak their tertiary education systems to change the system behaviour, and clearly no perfect static education system is possible. Intervention by government in tertiary education is therefore certain to be ongoing, and driven by perceived inadequacies in the system.

This can be problematic as the perceptions of inadequacy are influenced by politics, and ideology or personal worldview. The response tends to be reactive, and while it may remedy one problem it often introduces unanticipated perturbations, including the harming of desirable functions and the introduction of new unwanted behaviours. Decision-makers are often unable to anticipate these. In the NZ case it has been stated that if TEC is basing its key questions on an incorrect diagnosis it will certainly attempt to apply a set of remedial actions which will either be irrelevant or even dangerous [4].

The problem is that it is difficult to anticipate the behaviour of a complex system such as a tertiary education system. There are few, if any system models available, and not many methodologies to generate such models. The hypothesis in this paper was that a system model could be developed to qualitatively explain the observed behaviour of the NZ tertiary education system. This is worth doing as such a model may be able to (i) advance understanding of existing system behaviour, and (ii) help decision-makers anticipate the dynamic response of the system.

## 3 Method of system modelling

The only known attempt to develop a system model of the NZ education system is the work of Britton and McCallion [5]. They published an academic analysis of the NZ education system, concentrating on the vocational training part of the system. Those authors applied Beer's cybernetic model to document the authority structures involved. The model explained deficiencies in the education system of the time, and suggested actions that might make the system more viable and stable. However the education system they described, particularly the governing bodies, is barely recognisable today, such have been the changes already. The model is no longer applicable, although the method presumably would be.

This paper takes a different modelling approach, that of dynamic process analysis (DPA). This is based on integration definition (IDEF0) [6]. Compared to Beer's approach, an IDEF0 model is easier for a non-specialist to engage with, and it distinguishes between flows through a system and mechanisms and controls on that system. It is able to accommodate both quantitative and qualitative information. IDEF0 is a suitable tool for business process re-engineering [7]. It is a diagramming tool to assist comprehension of the interactions of various processes within a larger system. It is not a mathematical simulation system, though it can support and represent those activities. A more complete description of the DPA is provided (along with applications to other domains) in other prospective publications by the first author.

## 4 Results: System model for NZ Education

The resulting artefact from the modelling process is a set of diagrams, which make up the system model. The diagrams are arranged in a hierarchy, from overview through to increasing detail. When interpreting the diagrams it is important to note that IDEF0 represents activities in boxes, and objects as arrows. Also, it explicitly separates variables by type with inputs on the left, outputs on the right, constraints above and mechanisms (tools) below the box. The following diagrams are included in this paper. A brief overview is provided below. Please also see the caption of each diagram for additional descriptive text to aid interpretation.

*Undergo learning {Edu-3}* provides the overview of this model. In turn this model is embedded in a larger model, but this is not included here.

*International student selects a destination country {Edu-3-1}* explores the decisions process for foreign full-fee pay students. This is an important issue since (a) NZ tertiary education is critically dependent on foreign enrolments for its present financial viability, and (b) these enrolments have declined.

*Select institution at which to study {Edu-3-2}* anticipates factors that affect the all-important decision about where to study, and suggests that perceptions (e.g. esteem of institution, research ratings) appear to be more important factors than quality of teaching [8, 9, 10, 11].

*Study at tertiary education institution {Edu-3-4}* models some of the academic organisational activities that support the learning process. Financial considerations feature prominently since NZ education is competitive and financial survival is not automatic.

*Manage teaching section {Edu-3-4-2}* describes academic management processes. Two key outcomes to manage are teaching quality and research quality. Both of these affect future income streams. There is a risk of encouraging research at the expense of the teaching curriculum [12].

*Set financial budget {Edu-3-4-3}* describes the financial budget setting process. NZ institutions are critically reliant on income from international students to support local programmes. There is a risk of declining future foreign enrolments in NZ {Edu-3-1}, in which case NZ may not be able to support her current portfolio of programmes. Diversity and redundancy may decline.

*Senior management sets and implements strategies {Edu-3-4-4}* explores the strategic processes in tertiary organisations. The financial perspective dominates the decision process for senior managers at most teaching organisations. Most institutions perceive their financial survival as tenuous and uncertain. Some also perceive the state as more of an antagonist than a partner.

*Market programmes to public {Edu-3-4-5}* is a characteristic of the NZ system. Significant resources are put into marketing, because it affects financial viability. Generally the marketing effort is directed to enhancing the esteem of the organisation, e.g. using research ranking, even though this does not necessarily correlate with teaching quality. Advertising is effective, especially at the corporate level, but at the expense of other institutions [9]. Nonetheless, engineering programmes at many NZ organisations

have suffered declining enrolments. It therefore seems important that engineering schools have an active outreach programme, to awaken interest of school leavers in engineering.

*Establish and deploy marketing plan for subunit (dept or programme) {Edu-3-4-5-5}* shows an outreach model followed by one NZ engineering school. Results are as yet unavailable so the effectiveness is unknown.

## 5 Discussion

### 5.1 Observations

The NZ education system works well in most respects. The dominant failures are the destructive competition and the financial insecurity of the organisations.

The previous restructuring deliberately set out to create a competitive environment. The principle problem is that the entire MoE subsidy is attached to the student enrolment, and the student has no constraints on where or what is studied, other than meeting entrance requirements. Under those competitive constraints it has been acceptable for institutions to compete aggressively with each other, expend more marketing effort, seek to win more market share (including the establishment of additional campuses, commonly in the home cities of competing institutions), merge and form exclusive alliances, compete on the basis of fees, and seek out more profitable customers (even if that meant abandoning unprofitable programmes or localities). Education providers had no choice but to adopt the competitive model and its practices, in some cases to the detriment of the national good. The state architects appear not have anticipated the ferocity of the competitive behaviour. They also underestimated the extent to which institutions would adapt not only their behaviour but also their strategies, thereby creating totally new system dynamics. Competition did invigorate the system, but at a cost. Thus the excess competition of the current system should be seen as natural results of the prescribed operating conditions, and not malicious intent of the players.

The present financial insecurity of institutions also derives from the competitive funding model. This insecurity has led to innovative behaviour by institutions. Current education economics, in an environment of falling per student capita funding from government, require ongoing enrolment growth, but domestic enrolments are a depleted resource. There are limited new student customers, too many educational

products, and indiscriminate consumption of inconsequential courses, which indicate saturation of demand [13]. The institutions "are being forced to look outside their own regions to sustain their core market, that of the new school leaver" [9:6], and rely heavily on advertising to achieve this. Another way the growth strategy is satisfied is through institutional mergers, of which several have occurred. Institutions are likely to have to transition to strategies other than growth to maintain economic viability. This will be especially necessary if foreign enrolments or state subsidy decline, and the former is a real long-term risk. The financial pressure also results in institutions undertaking opportunistic projects. This innovative and customer-focussed behaviour is admirable, but may cause conflict. Some projects have been financially and legally ethical, but less easy to justify on academic grounds or consideration of the national good, e.g. dispensing computer training material without knowing whether students will engage with it [14], or the dispensing of cell phones/personal computers/money as an inducement to enrol [15]. The government is critical of what it sees as perverse innovation and bad decision making. However, it seems to want all of a flexible customer focussed tertiary sector, diverse education opportunities, low state contribution, innovative developments, high engagement with social groups that historically have not engaged with education, but no hostile competition and no perverse responses. The constraints that provide the set of benefits inseparably also provide the detriments.

Therefore there is a need for any future education system to ensure that the national good is achieved concurrently with providing quality education, in a way that simultaneously secures the financial viability of the participating institutions.

## 5.2 Possible changes to the education system

That the government intends further adjustment to the tertiary education system is clear. The mechanism that TEC intends using is to articulate the desired outcomes (the TES and STEP, see below) and then "have institutions use their autonomy and change their behaviour voluntarily to get the strategic focus and alignment sought within the tertiary system as a whole" [16:4]. If that mechanism fails, then TEC have stated the intent to use "intervention tools" when necessary [16:3]. The national objectives consist of a Tertiary Education Strategy (TES) 2 [17] and a

Statement of Tertiary Education Priorities (STEP)3 [18]. It is interesting that financial viability is not included in either, despite much of the current behaviour and strategy of institutions being motivated by financial prudence.

This is not an easy optimisation problem, especially as the variables are qualitative, the relationships between them are interdependent but uncertain, and the outcomes may even conflict with each other. It seems desirable, and perhaps even essential, to have some mechanism for assessing the current state of the system, and tuning it to move to more desirable operating states. It remains to be seen how the TEC mechanism will cope with the qualitative data and subjective knowledge, and nonetheless achieve outcomes that are effective, sustainable, and non-contentious.

The model present here illustrates the factors influencing organisational behaviour and that, in the absence of any closed loop feedback, organisations will tend to operate in almost pure competition and cause disruptive behaviour in the overall system. The model suggests that there could be beneficial effects to some explicit feedback control, such as control over the range of academic offerings, control over degree offering by polytechnics and sub-degree offerings by universities [19:14], or funding that was less EFTS driven. Other control mechanisms may be inferred from Figure Edu-3-4-4.

It is unclear to what extent the NZ state accepts that the current system behaviours, both positive and negative, are a consequence of the constraints that the state itself has constructed. Unless the underlying constraints are adjusted, it is difficult to see how reliance on voluntary compliance or intervention can be effective. As Simon [20] observed, 'the members of an organization or

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"Greater alignment with national goals, #Stronger linkages with business and other external stakeholders # Effective partnership arrangements with Maori communities # Increased responsiveness to the needs of, and wider access for, learners # More future-focused strategies # Improved global linkages # Greater collaboration and rationalisation within the system # Increased quality, performance, effectiveness, efficiency and transparency # A culture of optimism and creativity" [17]

3 The STEP provides the associated short term strategies, and includes: # "Strengthen System Capability and Quality # Contribute to the achievement of Maori Development Aspirations # Raise Foundation Skills so that all People Can Participate in our Knowledge Society # Develop the Skills New Zealanders Need for our Knowledge Society # Educate for Pacific Peoples' Development and Success # Strengthen Research, Knowledge Creation and Uptake for our Knowledge Society" [18]

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2 The TES provides the five-year strategic direction, and includes: #

society for whom plans are made are not passive instruments, but are themselves designers who are seeking to use the system to further their own goals' (p177). The process is like a game: 'the planners ... implement their design, and those who are affected by it then alter their own behavior to achieve their goals in the changed environment' (p177-178). Simon also noted that 'it is still rare for social planning and policy discussions to include in any systematic way the possible "gaming" responses to plans' (p178). The NZ state needs to find ways not simply to ban organisations operating in a particular (undesirable) way, but incentives for them to change to a different mode. This will necessarily involve financial considerations. Thus if a sector of organisations are prevented from operating in some area, then they need to have some compensatory mechanism that permits them to function fully in the space provided and reduces the necessity to take evasive action. It is precisely that evasive action which could again undermine the stability of the reforms.

### 5.3 Outcomes and Limitations

This work has provided a descriptive treatment of key characteristics of the NZ tertiary education system. It has integrated multiple sources of qualitative information into a model that provides a plausible explanation of existing system behaviour. It is readily acknowledged that this model is a construct of the analysts and is therefore subjective, and must be expected to be constrained in predictive power. The suggested causality might be an artefact of the prior knowledge of the analysts rather than a product of the methodology itself. Thus no claim is being made that successful creation of a model necessarily validated the methodology or the model. However, provided the analysts identify all relevant inputs and outputs then certain facets of system behaviour become evident, such as organisations setting new strategic direction to respond to changes to the system introduced by government. Organisational theory and basic laws used in this area, such as the law of requisite variety (a successful system needs, in the complexity of its internal systems and its flexibility of response, to be able to match the complexity of its environment) will always show organisations that survive and prosper responding to work in a turbulent and competitive environment by changing organisational behaviour and business strategy. If the model helps other organisations better understand and respond to their environment, then it will have achieved what its authors hoped.

The dynamic process analysis (DPA) methodology

used to construct this model of tertiary education is in many ways an embodiment of a philosophy proposed some years ago. Simon (1981) expected that complex systems could be 'constructed in a hierarchy of levels' (p148), and that 'each of the subsystems may be defined by describing the functions of that subsystem, without detailed specification of its submechanisms.' (p148). Furthermore, he believed that a powerful technique for designing complex systems was to 'discover viable ways of decomposing it into semi-independent components corresponding to its many functional parts' (p148), although 'there is no reason to expect that the decomposition of the complete design into functional components will be unique' (p149).

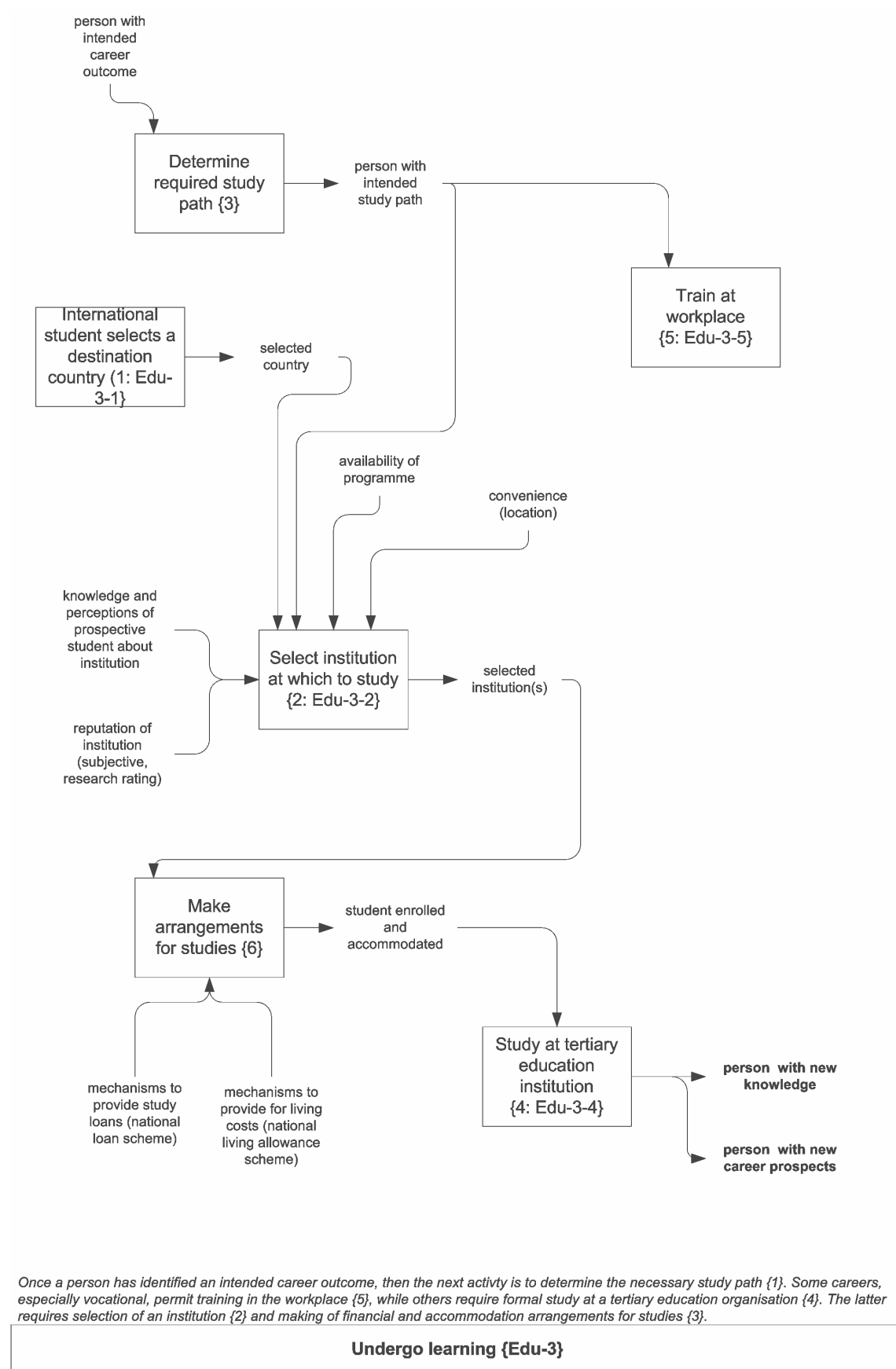
## 6 Conclusions

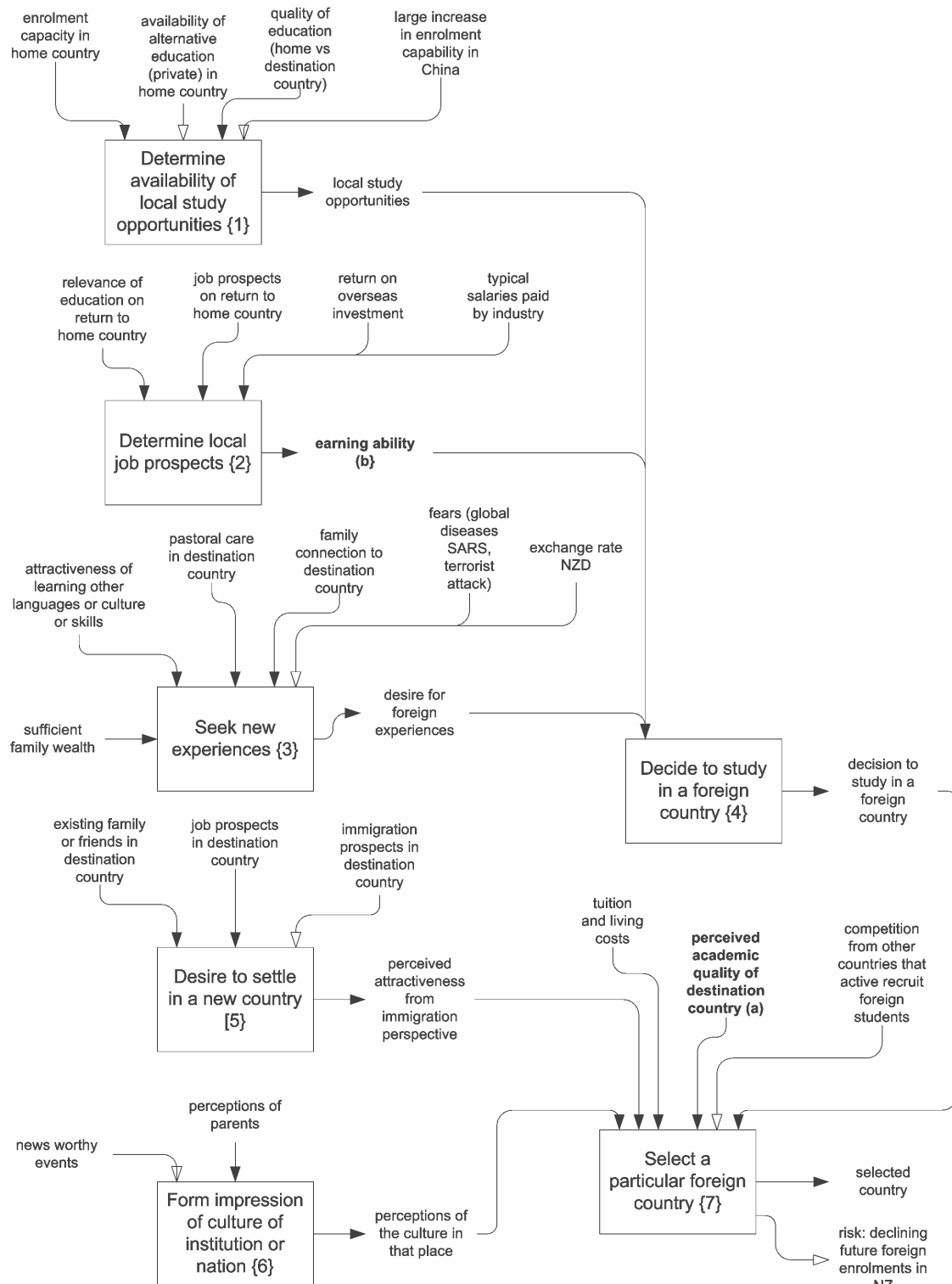
The NZ tertiary education currently operates on highly financially competitive principles. This is a consequence of the state distributing its entire teaching subsidy according to the student enrolment, with no constraints on where or what the student studied, and no other sources of state funding being available for capital or special needs. Furthermore, institutions have transformed themselves to meet the operating environment with proliferation of programmes, including expansion into academic areas formerly reserved for other institutions. Since the students enrolment decision carries the entire subsidy, institutions have had to focus on student needs before other priorities of the national good. Returning to the hypothesis, it has been shown that a system model could be developed to qualitatively explain the observed behaviour of the NZ tertiary education system. The model provides a useful means of breaking down the structure of the system and identifying the constraints and activities within the system. The results are presented in a manner intended to help other tertiary education organisations better understand and respond to their environment, and possibly even anticipate the dynamic response of the system.

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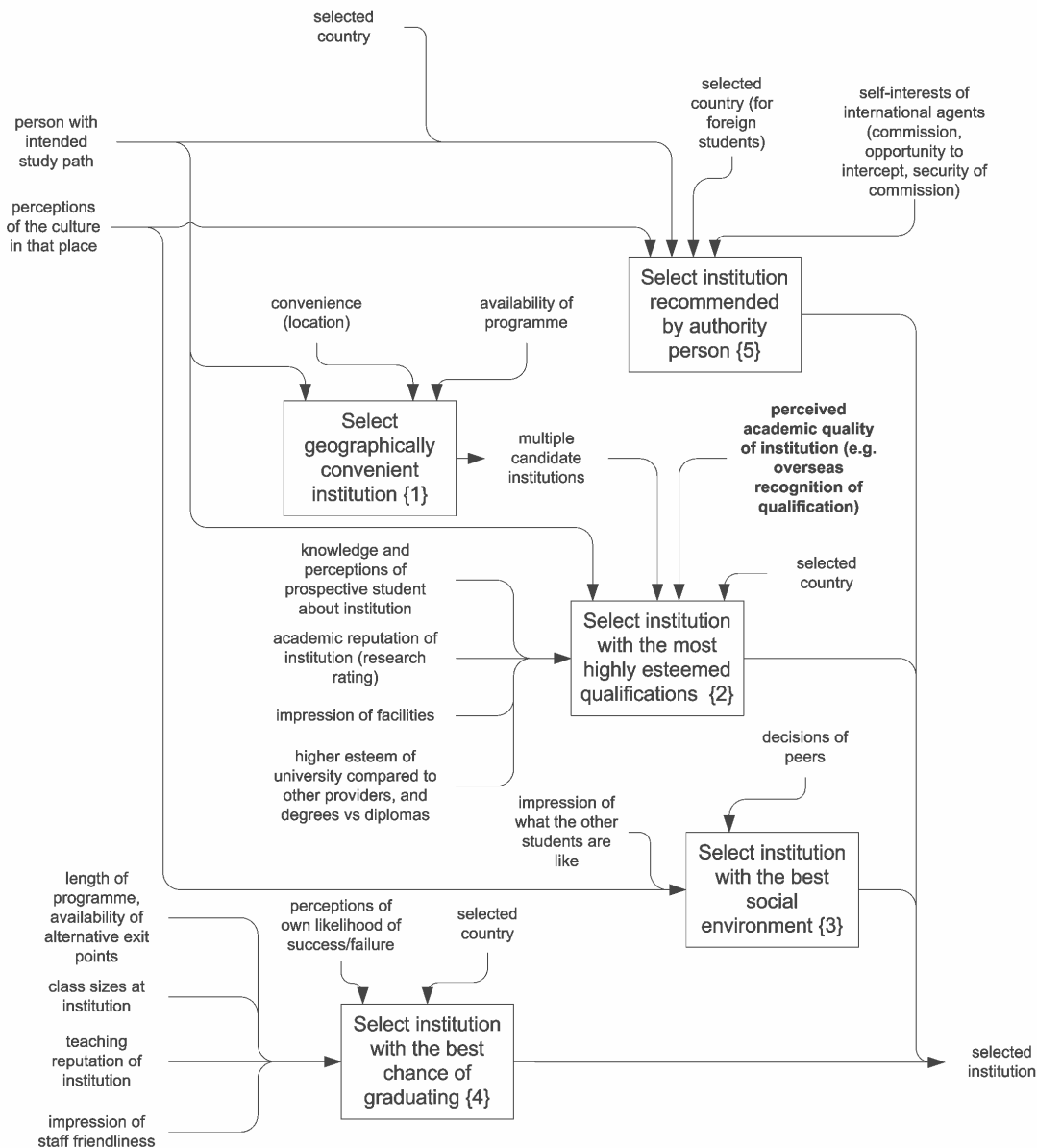
The financial viability of most NZ tertiary education institutions is critically dependent on foreign student enrolments. The peak was 118,684 students in 2003 (Li, 2004), but has since declined. This decline has significant financial implications for institutions. The above model postulates a decision process, primarily based on factors identified by Li (2004) and ER (2004).  
 ER, 2004, Australia losing international student market. *Education Review*, 9(40): 12.  
 Li, M., 2004, Keep the focus on quality. *Education Review*, 9(38): 6-7.

### International student selects a destination country (Edu-3-1)

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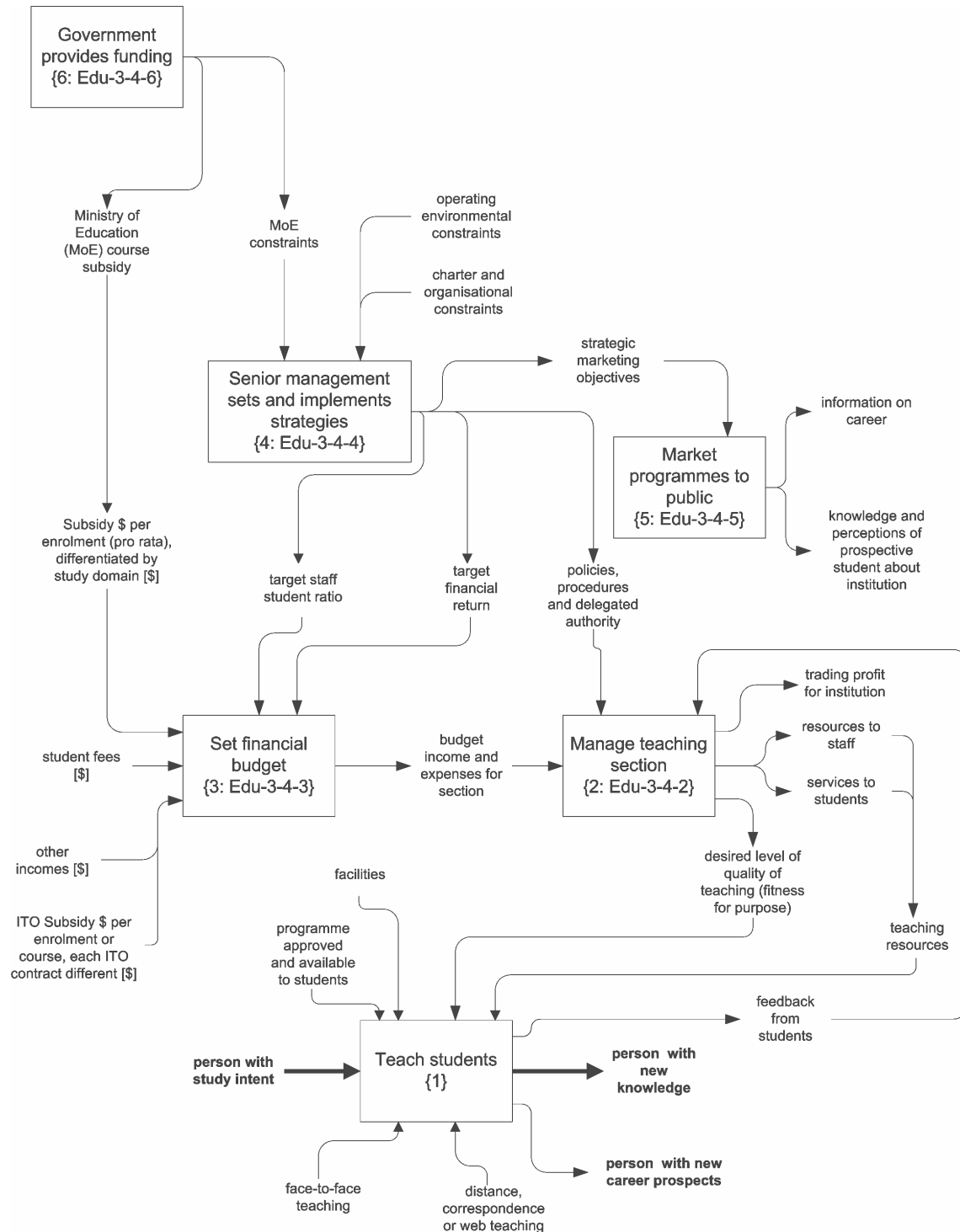
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The process whereby students select their institution of study is particularly important to NZ institutions because of the competitive funding environment. The entire state education subsidy goes to the institution that gains the enrolment, and there is no constraint on where or what the student elects to study. Thus, attendance at the most geographically convenient institution {1} does not necessarily occur, and institutions vigorously advertise in other cities. The esteem of the qualification {2} is important to students, and they may base that assessment on quantitative information such as research ratings, as well as subjective information. Also, since tertiary education is at least partly a social maturation process, students may also take into account the offered social environment {3}. Furthermore, it is anticipated that some students may select the institution with the best chance of graduating {4}, which may include factors such as teaching reputation, class size, alternative exit points and staff friendliness. However, institutions seldom include this type of material in their marketing, but instead tend to emphasise the esteem aspects of {2} because they feel that it gives confidence to students (Nixon, 2004). Nor does teaching quality feature highly on entry surveys (author's personal observation). It is particularly surprising that polytechnics do not differentiate themselves from universities using {4}, since they have the most to lose in any comparison based on esteem. In some cases, especially international students, the selection of institution may be heavily influenced by a person of authority {5}, such as an agent. As such agents work for commission, the enrolment is subject to the self-interest of the agent, and unethical behaviour is known to sometimes occur (Thomson, 2004). Nixon, M., 2004, Sell, sell, sell - TEIs put marketing strategies to work. *Education Review*, 9(38): 6-7. Thomson, R., 2004, Crooked agents drive students to Australia. *Education Review*, 9(38): 1.

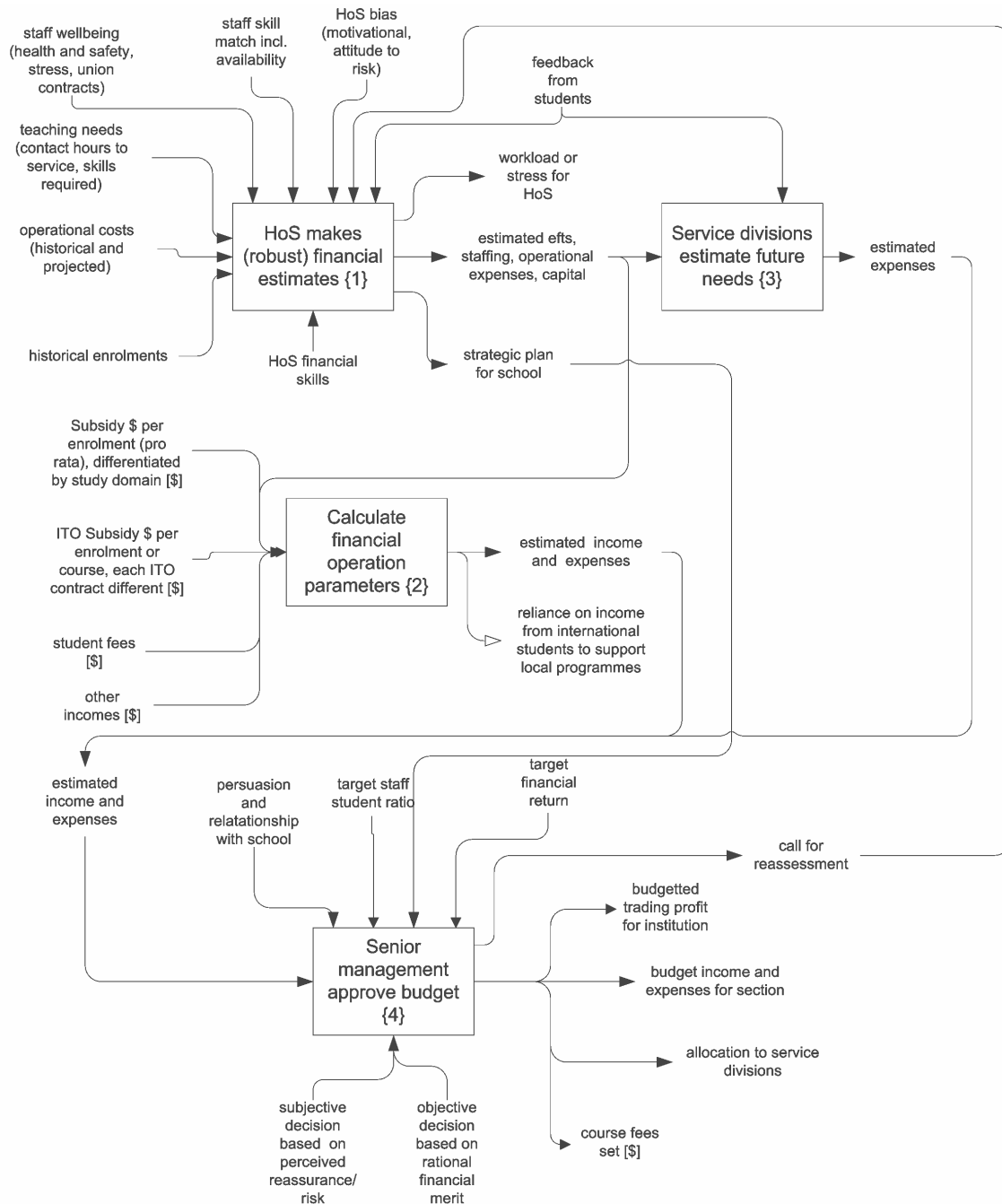
### Select institution at which to study {Edu-3-2}



The primary process, at least from the student perspective, is teaching {1}. However, there are other important processes that affect the teaching, including those of Manage teaching section {2}, Set operational constraints {3}, Management sets and implements strategies {4}, and Market programmes to public {5}. The provision of government subsidy {6} is an essential component in the viability of the system. The model applies to both Universities and Polytechnics (Institutes of Technology).

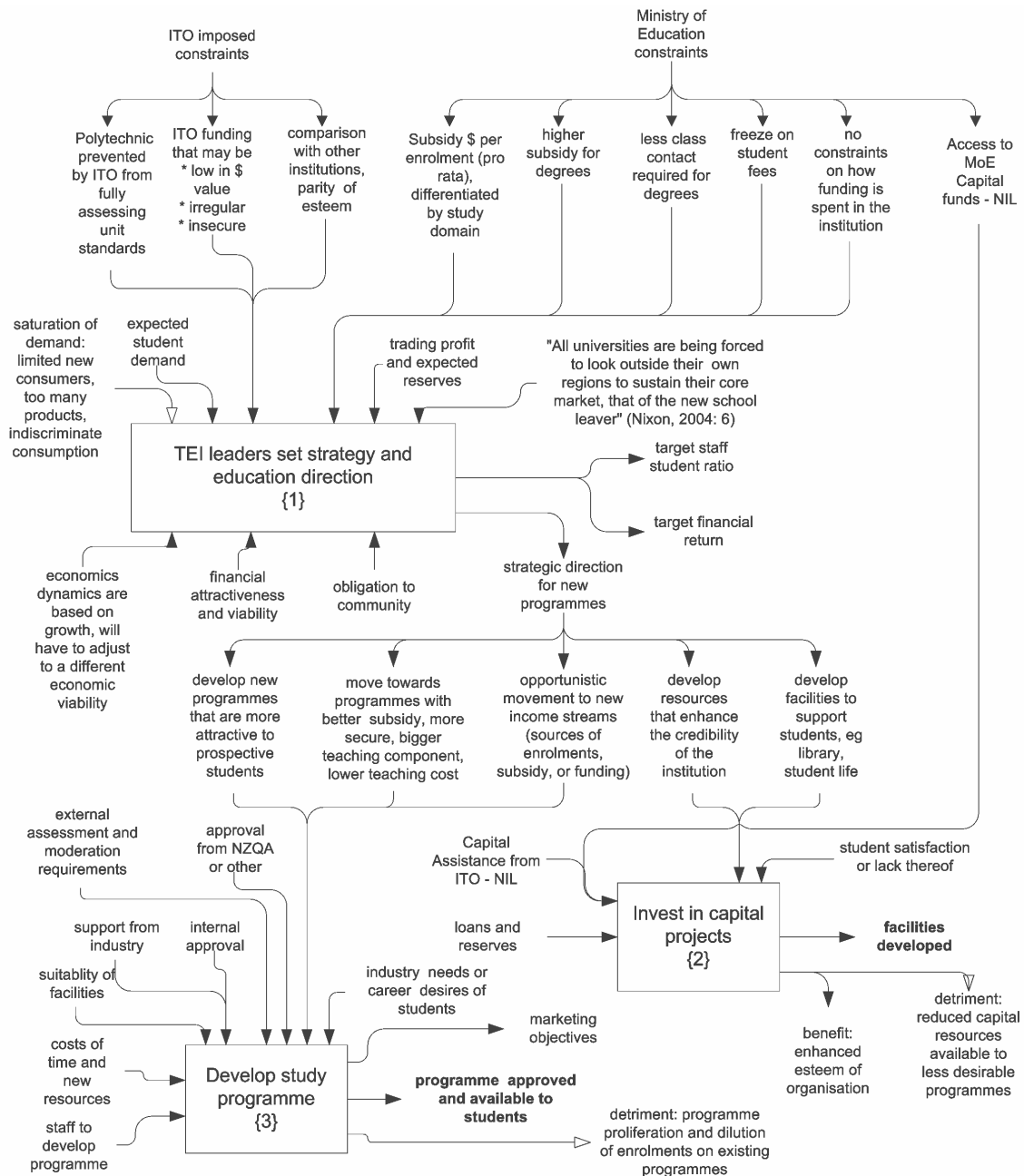
### Study at tertiary education institution {Edu-3-4}





Financial budget processes originate with the manager making financial estimates {1}. Ideally these will be robust as they affect the overall institution. Generally heads can accurately determine labour and resource costs, providing they have historical data. However, estimating income from enrolments has proved to be difficult in NZ. This is evident in large deviations between budget and actual enrolments at school level, though the full extent of the problem is difficult to quantify as the information is confidential. The problem is usually not so much the changeable rate of government subsidy as uncertainty about enrolments. Enrolments in engineering programmes at most NZ Polytechnics have generally been in decline over the last 5 yrs, especially domestic enrolments. This decline has been partly offset by increased foreign enrolments. However, these can be fickle and vulnerable to changing perceptions of the suitability of NZ as a study destination. The estimates provided by the Head are then used to Calculate financial operation parameters {2}, and for Service divisions to estimate future needs {3}. Finally, Senior management approve the budget {4}, possibly after several iterations.

### Set financial budget {Edu-3-4-3}



The process by which senior managers create strategic direction {1} is uncertain. Management science shows that decisions are generally not made rationally; instead managers grope through problems with their intuition, often using an accelerated decision process involving only a cursory search for information, and a reliance on past experience, premature information and heuristics (biases) (Wagner, 1991). Creating a model for decision-making at senior levels of a teaching organisation is thus difficult. However, it is at least possible to identify some of the major constraints. The strategic activities of senior education managers are primarily focused on financial perspectives. This is because most NZ teaching institutions perceive their financial survival as tenuous and uncertain. There are strong incentives for managers to be innovative and escape the constraints by moving the organisation to a new operating environment {1}. Much of the strategic effort in the NZ education sector is directed towards capital projects {2} and development of new programmes {3}. Building projects are particularly attractive as they add capability and also enhance the esteem of the organisation. There is regular creation of new academic programmes, not simply refreshing of old, in an attempt to provide programmes that are more attractive to prospective students and which provide the organisation with better financial viability.

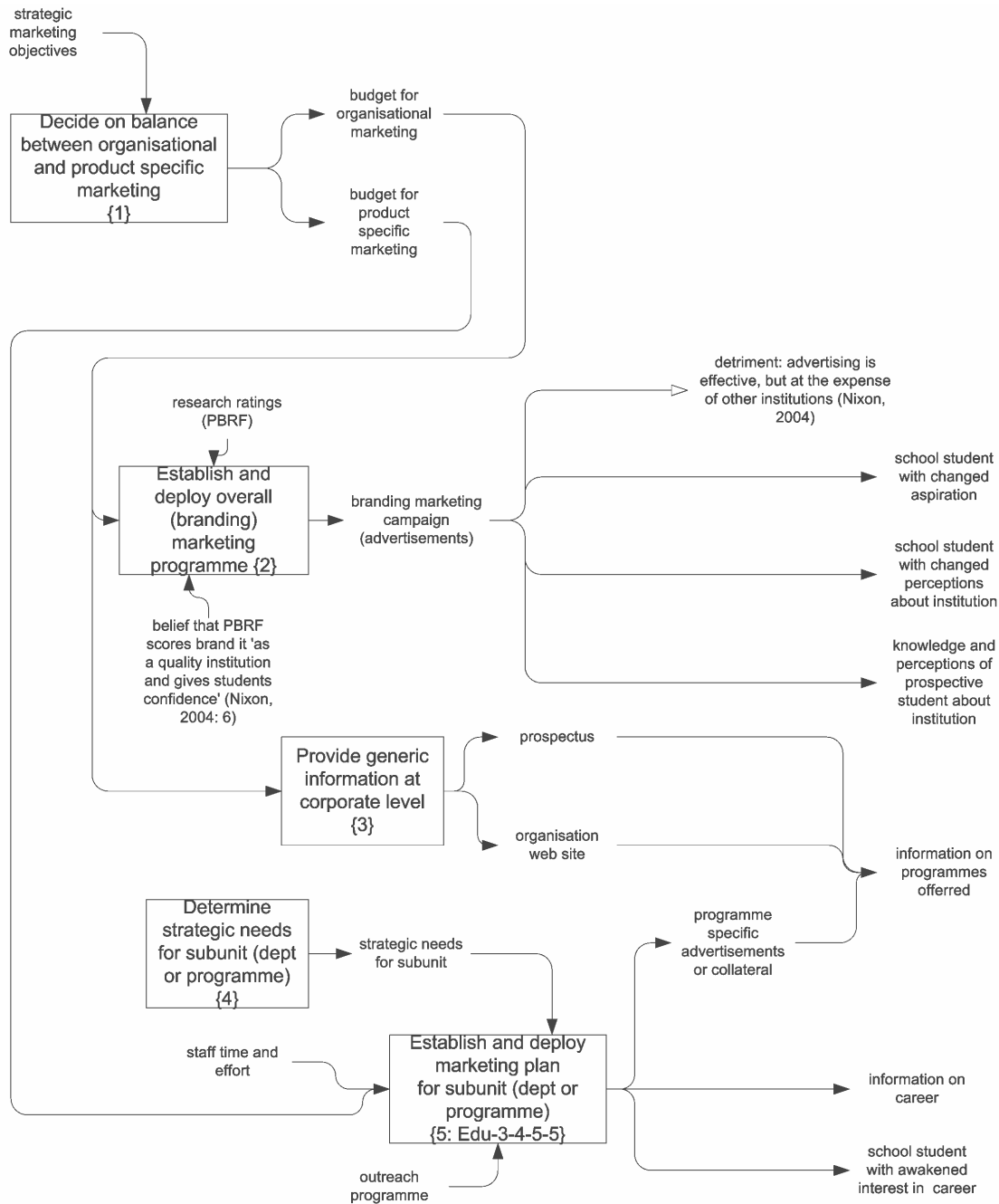
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Wagner, R., 1991, Managerial problem solving. *Complex problem solving: principles and mechanisms*. In Sternberg, R. and Frensch, P. (ed). Hillsdale, New Jersey, Lawrence Erlbaum Associates: 159-183.

### Senior management sets and implements strategies {Edu-3-4-4}

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Education organisations make extensive use of marketing and advertising to secure enrolments. Some of this is organisational branding, in which characteristics that enhance perceived esteem (e.g. the research ranking of the institution) feature prominently. Other marketing effort is directed at the career or at least programme level. Several different outcomes are identified (left side of diagram), corresponding to marketing objectives. These include changing the aspirations, perceptions, and knowledge of prospective students about the institution or the career. Most of the formal marketing effort is directed at changing perceptions about the institution, or providing knowledge about the programmes offered. The problem is that engineering programmes at many NZ organisations are suffering from declining enrolments (anecdotal evidence), and part of this is due to negative perceptions about engineering careers (unpublished CPIT market research, 2003). It is therefore important that engineering schools have an active outreach programme, to awaken interest of school leavers in engineering.

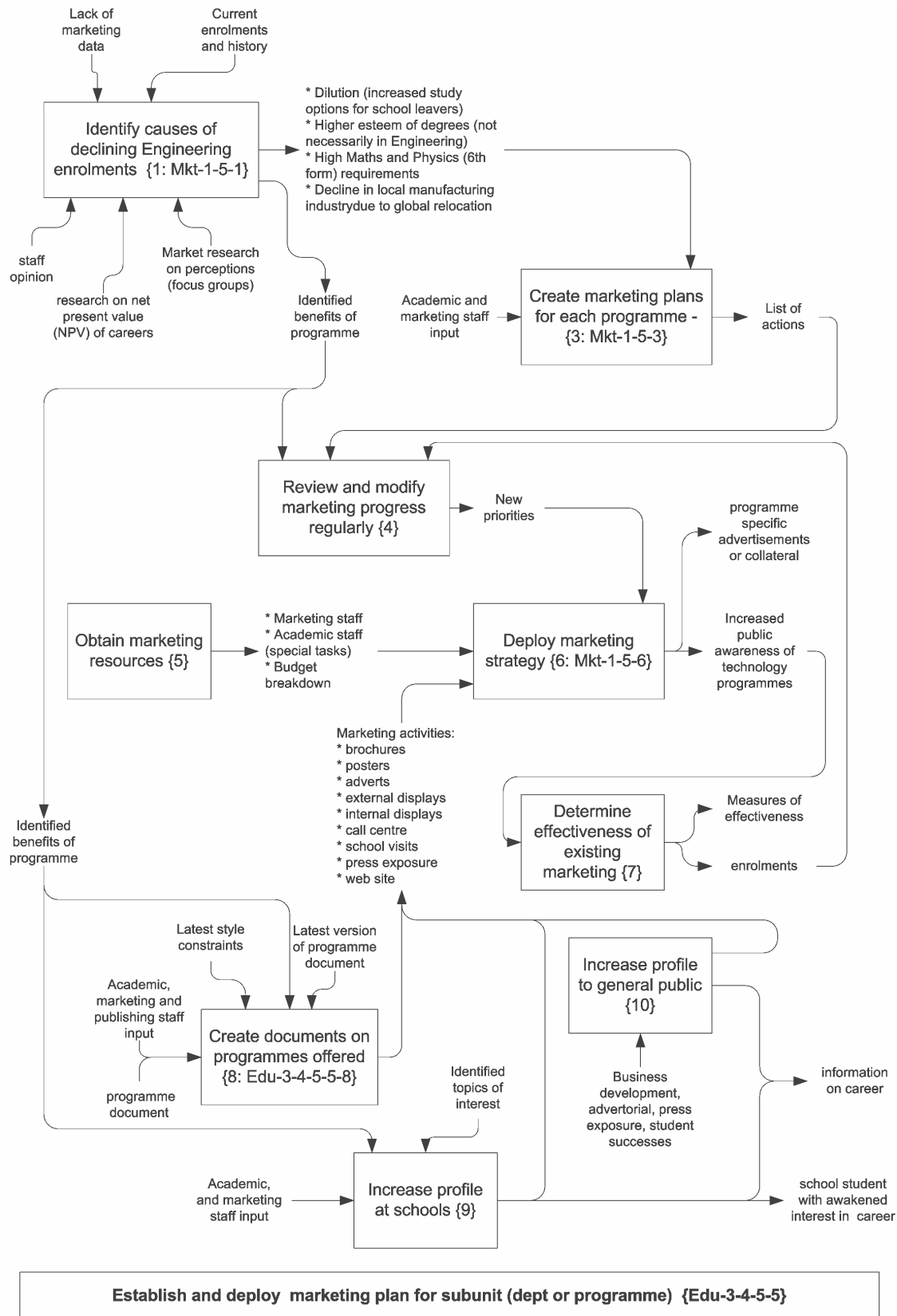
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### Market programmes to public {Edu-3-4-5}

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